

**SEPARATING FOREIGN OBJECTS
FROM A MASS OF COINS**

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. provisional patent application serial number 60/414,486, filed on September 27, 2002 and to U.S. provisional patent application serial number 60/448,323, filed on February 19, 2003. This application also claims priority to U.K. application number GB 0222439.2, filed on September 27, 2002 and to U.K. application number GB 0303434.5, filed on February 14, 2003.

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INCORPORATION BY REFERENCE

The specifications of U.S. provisional patent application serial number 60/414,486 and U.S. provisional patent application serial number 60/448,323 are incorporated herein in their entirety, by this reference. The specifications of U.K. patent application number GB 0222439.2 and U.K. patent application number GB 0303434.5 are incorporated herein in their entirety, by this reference.

FIELD OF THE INVENTION

20 The present invention relates to apparatus and method for separating foreign objects from a mass of coins.

The term ‘coin’ will be used herein to include coin-like articles such as tokens, and blanks.

BACKGROUND OF THE INVENTION

25 The present invention stems from a need to separate foreign objects from a mass of coins inserted into a machine, often by the public, in order to provide a total value of the coins. Such machines are increasingly being provided in

public places, such as supermarkets to enable the public to dispose of their small change.

It should, however, be appreciated that the invention is not restricted to use in such self-service bulk coin counters but may have use in other coin-handling
5 machines in situations where the coins inserted into the machine may have mixed with them foreign objects of various kinds.

In the absence of a separation device, the foreign objects are liable to jam the machine, or reduce the efficiency of the machine.

The foreign objects can be of various kinds such as fluff and all manner of
10 items which are found in pockets and purses, such as pencils, buttons and pens, lipsticks etc, in short any item that can get picked up inadvertently with a batch of coins when the coins are loaded into a coin sorting/counting machine by a member of the public. In an industrial situation, such as a mint, contaminants of various kinds can arise, such as maize, shot and other
15 abrasive and cleaning media.

Various types of coin cleaning devices for cleaning a mass of coins, prior to it being processed by a coin processing device, are known.

US 5482916 discloses a coin conditioning device comprising a rotatable container, having perforated walls and vanes for causing the mass of coins to
20 be conveyed forward through the container. The described coin conditioning device works like a screw tube conveyor, causing the mass of coins to tumble inside the conveyor, while non-coin matter is allowed to fall out of the container through the perforations in the walls.

WO 96/30877 discloses a similar, rotatable coin cleaning device, wherein the
25 vanes are replaced by a screw conveyor that is arranged inside the perforated container.

The present invention stems from some work to provide a coin cleaning device which is fast and which provides an even flow of coins to the components downstream of the coin cleaning device.

SUMMARIES OF THE INVENTION

5 According to one aspect of the invention a coin cleaning device for separating foreign objects from a mass of coins inserted into the device, comprises a coin receiving means into which a batch of coins may be inserted, an elongate tray assembly, an inlet end of the tray assembly being so arranged as to receive coins from the coin receiving means, a vibration means connected to
10 the tray assembly and so arranged as in use to cause coins on the tray assembly to travel along the tray assembly in the direction away from said inlet end, the tray assembly comprising upper and lower shelves which are substantially horizontal in use, the upper shelf comprising a first upper shelf portion and a second upper shelf portion, the first upper shelf portion being disposed towards said inlet end, and the second upper shelf portion being disposed away from said inlet end, the first upper shelf portion being perforated by apertures of transverse dimensions smaller than the minimum diameter of coins to be handled by the device, whereby some foreign matter of transverse dimensions smaller than the perforations can fall through the
15 perforations of the first upper shelf portion, the second upper shelf portion being formed with coin receiving apertures of transverse dimensions larger than the maximum diameter of coins to be handled by the device, whereby coins which travel from on top of the first upper shelf portion to the second upper shelf portion fall through said coin receiving apertures, the lower shelf
20 extending beneath the second upper shelf portion and being provided with perforations of transverse dimensions smaller than the minimum diameter of coins to be handled by the device whereby any foreign objects which are associated with coins that tumble through the apertures of the second upper shelf portion, can pass through the lower shelf, as the coins are conveyed
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along the lower shelf, and a coin outlet positioned to receive coins from the downstream end of the lower shelf.

Such a device provides two cleaning steps for the coins, the first step being associated with the passage of the coins along the first upper shelf portion,
5 and the second step being associated with the passage of the coins along the lower shelf. Moreover, in falling through the upper shelf and down onto the lower shelf the coins are tumbled which can help to separate any remaining foreign matter from the coins so as to encourage that foreign matter then to fall through the perforations of the lower shelf.

10 The device may comprise an additional shelf portion in said coin outlet, said additional shelf portion being perforated with apertures of transverse dimensions smaller than said minimum coin diameter.

The device preferably comprises a large object collection means adapted to collect any objects that are sufficiently large as not to fall through the
15 apertures of the second upper shelf portion.

The large object collection means preferably comprises a chute which is open to the downstream end of the second upper tray portion and extends downwards to a bin, which is conveniently the reject cup in a coin sorter.

20 The bin is preferably located behind a door of the machine for easy emptying of the bin as and when required, or the bin may be permanently accessible through an opening in an external panel of the machine.

One advantageous construction of said elongate tray assembly comprises a self-contained upper tray spaced from a self-contained lower tray by a plurality of rigid spacers, each spacer being associated with a respective
25 releasable fastener, the arrangement being such that when the fasteners are in a secured condition the upper tray is rigidly connected to the lower tray by

said spacers and fasteners, and when the fasteners are released the upper tray is removable from the lower tray.

The associated spacers and fasteners are preferably located substantially at opposite ends of the upper tray.

- 5 The combined mass of the spacers and fasteners at one end of the upper tray can be arranged to be different from the combined mass of the spacers and fasteners at the other end of the upper tray, in order to provide differing vibration characteristics of the tray assembly along the length thereof.

- 10 Desirably the combined mass of the spacers and fasteners at the upstream end of the tray assembly is chosen relative to the combined mass of the spacers and fasteners of the downstream end so as to cause coins to become more spaced-apart as they proceed along the tray assembly, and thereby helps to avoid a sudden surge of coins reaching the outlet.

- 15 The spacers at the downstream end preferably comprise a hollow column, and the fastener extends through the bore of the column.

The spacers at the upstream end are conveniently constituted by a single block which extends transversely across the tray assembly, a plurality of laterally-spaced apart fasteners extending through respective bores provided in the block.

- 20 The block can be provided with apertures sized according to the required mass of the block.

- 25 According to a second aspect of the invention we provide a coin cleaning device for separating foreign objects from a mass of coins, comprising at least two shelf portions arranged at different heights, vibration means for vibrating the shelf portions to cause coins on the shelf portions to be conveyed along

the shelf portions, said shelf portions each being perforated by apertures of transverse dimensions smaller than the minimum diameter of coins to be handled by the device, whereby foreign matter of transverse dimensions smaller than the perforations can fall through the perforations, the shelf
5 portions being arranged in series with one another, such that coins conveyed along a first of the shelf portions then tumble downwards to lie on the second shelf portion and are then conveyed along the second shelf portion to a coin outlet.

According to a third aspect of the invention a coin sorting and/or counting
10 machine is provided with a coin cleaning device in accordance with the first or second aspect of the invention, the coin outlet of the device leading into the coin sorter and/or counter of the machine.

The machine preferably comprises a coin sorter and/or counter of the inclined disc type in which coins to be counted and/or sorted are held in a hopper and
15 are picked out in turn by the disc.

Preferably the hopper is disposed to one side of the elongate tray assembly, as viewed in plan, and a coin delivery chute, directed substantially transversely of the tray assembly, conveys coins falling from the downstream end of the lower shelf into the hopper. This enables the tray assembly to be located
20 towards the front of the machine, which can improve accessibility to the tray assembly for maintenance, and facilitates the coin receiving means being located towards the front of the machine.

Any other known type of coin sorter and/or counter may benefit from the inventive coin cleaning device being arranged to clean the coins before they
25 are handled by the sorter/counter.

According to a fourth aspect of the invention a method of separating foreign bodies from a mass of coins comprises causing the coins to be vibrated along an upper shelf portion provided with perforations of a dimension smaller than the minimum diameter of coins to be handled, causing the coins to tumble 5 from the downstream end of the upper shelf portion onto a lower shelf portion, said lower shelf portion also being provided with perforations of a dimension smaller than the minimum diameter of coins to be handled, and being vibrated to cause the coins to travel along the lower shelf portion, collecting foreign objects that have fallen through the perforations of either 10 the upper shelf portion or the lower shelf portion, and collecting the cleaned coins dispensed from the downstream end of the lower shelf portion.

The various aspects of the invention will now be further described, by way of example only, with reference to the accompanying drawings in which:-

BRIEF DESCRIPTION OF THE DRAWINGS

15 **Figure 1** is a perspective partial view of a batch coin sorter and counter machine provided with a coin cleaning tray assembly in accordance with the invention, the machine being shown with front and side outer panels removed,

20 **Figure 2** is a view of the machine with the coin tray assembly disassociated from the machine to reveal the hopper coin sorter and counter,

Figure 3 is an enlarged perspective view of the coin tray assembly of the machine of Figure 1,

Figure 4 is a plan view of the coin tray assembly,

25 **Figure 5** is a longitudinal vertical cross-section of the coin tray unit on the line 5-5 of Figure 4,

Figure 6 is a transverse cross section of the tray unit on the line 6-6 of Figure 4,

Figure 7 is an end elevation of the hopper and tray assembly of the machine of Figure 1, looking in the direction of the arrow A in Figure 5 but with a machine side panel removed,

Figure 8 is a schematic perspective view of a modification in which the coin tray assembly is suspended on anti-vibration mountings from the lid of the machine, the view showing the lid in a fully raised condition.

10 **Figure 9** is a plan view of a modified assembled tray assembly in accordance with the present invention and shown in an assembled condition;

Figure 10 is a side elevation of the assembled tray assembly looking in the direction of the arrow A in Figure 9;

15 **Figure 11** is a section on the line 11-11 of Figure 9;

Figure 12 is a section on the cranked line 12-12 of Figure 9; and

Figure 13 is an enlargement, on a scale of 2:1, of the portion of Figure 12 indicated in broken outline by the arrow B.

DESCRIPTION OF PREFERRED EMBODIMENTS

20 With reference to Figures 1, 2 and 7, a coin sorting and counting machine 1 comprises an upright rectangular housing 2 closed at its upper end by a top panel 3 formed with a coin receiving recess 4 into which a customer can place a batch of coins. At the left hand end of the recess 4, in Figure 1, this is a

large slot 6 into which the user can brush coins from the recess 4 in order to direct the coins into the machine for counting.

A coin cleaning assembly 7 comprising an elongate tray assembly 10 is disposed below the top panel 3 and is mounted on drawer slides 8 to enable 5 the entire coin cleaning assembly 7 to be drawn forwards from the operative position shown in Figure 1, when the front panel (not shown) of the machine is opened.

As shown in Figures 2 and 7 a coin sorter and counter assembly 11 of the well-known hopper type is positioned at a lower level of the machine than the 10 tray assembly 10 and is disposed rearwardly of the coin cleaning assembly 7.

Tray assembly 10 is supported at opposite ends thereof on resilient supports 12 above a rigid chassis 13, and a vibration means 14' of well-known type is arranged to act between the chassis 13 and the tray assembly 10 to cause the tray assembly to be vibrated in a manner such that coins on the tray assembly 15 are caused to be conveyed along the tray assembly from the left hand end in Figures 1, 2 and 3 towards the right hand end.

This is achieved, in a known manner, by arranging the axis of the excitation means 14' to be directed upwardly at an acute angle to the longitudinal axis of the tray assembly.

20 The vibration means 14' comprises a coil and an armature assembly mounted on a vibrator yoke 32 secured to the underside of the tray assembly. The coil may be energised at mains frequency, either using a mains voltage AC. power supply, or at a reduced voltage by use of a transformer.

25 It is preferably arranged that the vibration means 14' vibrates the tray assembly at a frequency close to, but not at, the resonant frequency of the tray assembly. For example, if the resonant frequency is 65 cps then a vibration

frequency of about 62 cps would be optimum. An adjustment means could be provided to adjust the resonant frequency of the tray assembly. Alternatively, an adjustable frequency converter could be provided in the supply to the coil of the vibration means 14'.

- 5 As is known to the skilled person in the vibrating conveyor field, the axis of the vibrating coil is preferably arranged to extend substantially through the centre of gravity of the tray assembly 10 so as to help minimise the transmission of vibrations to other parts of the machine. This is assisted by anti-vibration rubber mountings 8'.
- 10 With reference to Figures 3 to 6, the tray assembly comprises upper and lower perforated shelves 13 and 14 respectively which both extend substantially horizontally. The upper shelf 13 comprises a first upper shelf portion 15 extending from the upstream end 17 of the tray assembly, and a second co-planar upper shelf portion 16 extending from the downstream end of the first upper shelf portion 15 towards the downstream end 18 of the tray assembly.
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Beyond the downstream end of the second upper shelf portion 16 there is disposed a large rectangular aperture 20 for receipt of any very large foreign bodies, those which are too large to pass through the apertures of the second upper tray portion 16.

- 20 In order to prevent coins falling sideways from the upper shelf 17, upstanding sidewalls 21 extend around the upper shelf 17.

A lower tray wall 22 is disposed beneath the first upper shelf portion 15 in order to collect foreign matter which falls through perforations 23 in said portion 15. The perforation 23 are chosen to be of a diameter that is less than 25 a predetermined minimum diameter of coins to be fed to the coin hopper 11,

so that coins to be sorted and counted do not pass to the foreign bodies outlet 23 leading from the downstream end of lower tray wall 22.

The second upper shelf portion 16 is formed with apertures of a diameter that is larger than the predetermined maximum diameter of coins to be handled by 5 the coin sorter/counter 11, so that all such coins which pass from the downstream end of the first shelf portion 15 ultimately fall through one or another hole in the second upper shelf portion 16. Most coins will tumble through the first few holes encountered in the second upper tray portion 16 to tumble downwards and land on the lower shelf 14, or onto other coins already 10 thereon.

Lower shelf 14 is perforated by apertures of similar dimensions to those of the first upper shelf portion 15, to enable any remaining small foreign items to fall through the apertures of the lower shelf 14 as the coins travel along the lower shelf 14, the coins proceeding to the left in Figures 4, 5.

15 As shown in Figures 5 and 6, a coin delivery chute 25 is positioned at the downstream end of the lower shelf 14. Delivery chute 25 is of square outline in plan and comprises substantially triangular vertical side walls 26, and a sloping base 27 which is perforated with holes of a diameter similar to those in first upper shelf portion 15 and those in lower shelf 14, for the same 20 purpose of permitting small foreign bodies to fall through the base 27.

The slope of the base 27 causes coins to slide sideways down the chute 25 to be directed into the hopper 11, as can be seen from Figure 7.

A removable foreign matter collection tray 40, Figure 3, is positioned in the machine beneath the tray assembly 10 to collect the foreign matter which falls 25 through the various portions of the tray assembly. A foreign matter collection chute 41, best seen in Figures 3 and 5, extends below opening 23 and beneath

shelf portion 14 to direct foreign matter from shelf portions 15 and 14 into the tray 40.

A large item chute 30, Figure 3, leads to a large item bin 31, Figure 1, which is readily accessible at the front of the machine, either on opening of a front 5 panel of the machine, or if desired through an opening provided in the front panel, in which case bin 31 may simply be the coin reject cup of the machine.

The illustrated construction of tray assembly provides a compact structure that is effective to separate foreign matter from a mass of coins introduced through the inlet slot 6 of the machine. There are no rotating parts that could 10 become jammed, yet the coins are subject to many oscillations in travelling from the inlet slot 6 to the outlet of chute 27. Furthermore the coins are tumbled in passing from the upper shelf to the lower shelf, and many coins will also tumble in passing from the lower shelf 14 to the chute 27, all helping to separate foreign items from the coins.

15 Figure 8 shows a modified arrangement for supporting a tray assembly which is otherwise substantially the same as the tray assembly of Figure 3, and like reference numerals have been applied to like parts.

In the Figure 8 construction, the entire tray assembly 10 is suspended from the machine lid 3, opposite ends of the try assembly carrying mounting lugs 20 42 which are connected to respective yokes 43, 44 by way of three resilient mountings 45, 46 respectively.

This mounting arrangement for the tray assembly helps to isolate the remainder of the machine from vibrations, and also enables the underside of the tray assembly to be readily accessed, simply by raising the pivoted lid 3, 25 as shown in Figure 8.

In Figure 9 to 13, parts corresponding to those of the tray assembly of figures 3 to 6 have been given corresponding reference numerals.

As shown in the drawings the tray assembly comprises an upper elongate tray 13 rigidly supported above a lower elongate tray 14 by means of spacers 50, 51. Each tray 13, 14 is of shallow trough shape in transverse section.

The spacers 50 at the downstream end of the upper tray 13 are in the form of tubular pillars and are clamped between the undersurface of upper tray 13 and the uppersurface of lower tray 14 by respectively associated screws 52 which extend through the bores of the spacers 50. The screw heads 53 are received 10 in complementary recesses defined in the upper surface of tray 13 by frusto-conical formations 54 such that the screw heads 53 do not protrude above the base of tray 13.

At the upstream ends of the trays 13 and 14 they are rigidly spaced apart by an oblong-rectangular spacer block 51 which extends transversely across the 15 trays 13, 14 and is provided with three stepped vertical bores 55 to receive respective screws 56 similar to screws 52.

Screws 52 and 56 are threadedly engaged at their lower ends in downwardly projecting tubular bosses 57 pressed from the material of the base of lower tray 14.

20 A suitable proprietary screw locking material is used to prevent the screws 52 and 56 from vibrating loose in use of the tray assembly.

The relative masses of the spacers 50 and 51 are chosen so as to provide a difference in the vibration characteristics of the trays 13, 14 in proceeding from the upstream end of the trays. In particular, the downstream end of the 25 trays will tend to jump more than the upstream end and will cause the coins to become more spaced apart in the longitudinal direction of the trays, as the

coins move along the trays. This is due to the centre of gravity 60, Figure 2, of the tray assembly being located rearwards of the line of action 61 of the vibrator.

The ability to disconnect the upper tray from the lower tray enables different
5 trays to be used for handling different ranges of coins, the holes in the trays
being chosen according to the diameter of the coins to be handled.

Instead of employing screws as the fasteners, it may be desirable in some
cases to employ quick-release clamps.